

**USDA-ARS/
U.S. Wheat and Barley Scab Initiative
FY11 Final Performance Report
July 13, 2012**

Cover Page

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Fiscal Year:	FY11
USDA-ARS Agreement ID:	59-0206-9-059
USDA-ARS Agreement Title:	Genetics and Breeding of FHB Resistant Soft White Winter Wheat for the Northeastern U.S.
FY11 USDA-ARS Award Amount:	\$ 42,182

USWBSI Individual Project(s)

USWBSI Research Category*	Project Title	ARS Award Amount
VDHR-NWW	Breeding of FHB Resistant Soft White Winter Wheat for the Northeastern U.S.	\$ 17,910
VDHR-NWW	Coordinated Evaluation and Utilization of Marker Assisted Selection.	\$ 10,188
VDHR-NWW	Improved Breeding for FHB Resistance by Advanced Genetic and Phenotypic Characterization of Soft Winter Wheat.	\$ 10,879
	Total ARS Award Amount	\$ 42,182



Principal Investigator

June 8, 2012

Date

* MGMT – FHB Management
 FSTU – Food Safety, Toxicology, & Utilization of Mycotoxin-contaminated Grain
 GDER – Gene Discovery & Engineering Resistance
 PBG – Pathogen Biology & Genetics
 BAR-CP – Barley Coordinated Project
 DUR-CP – Durum Coordinated Project
 HWW-CP – Hard Winter Wheat Coordinated Project
 VDHR – Variety Development & Uniform Nurseries – Sub categories are below:
 SPR – Spring Wheat Region
 NWW – Northern Soft Winter Wheat Region
 SSW – Southern Soft Red Winter Wheat Region

Project 1: *Breeding of FHB Resistant Soft White Winter Wheat for the Northeastern U.S.*

1. What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?

Our goal in this project is to develop FHB resistant varieties for the northeastern U.S. Our FHB screening and evaluation nurseries and our testing program are very efficient and accurate. Our irrigation capacity is now sufficient for our breeding program as well as our mapping activities.

We have released 5 soft winter wheat varieties (4 white and 1 red) that have moderate resistance to FHB. Although there has been a reduction in white wheat acreage in NY in recent years, it has stabilized at an estimated 20% of the wheat acreage. We have co-released a new soft red winter wheat with Ohio State named Otsego for which certified seed production is sold out for this fall. In addition, we are planning a release and seed increase of OH02-12686 that has even better FHB resistance this fall. The problems with branded varieties whose FHB resistance is unknown before sale to farmers, has not been resolved. By the time we get FHB data on them, they are gone and replaced with something new, often susceptible to FHB or other diseases in our region.

2. List the most important accomplishment and its impact (i.e. how is it being used) to minimize the threat of Fusarium head blight or to reduce mycotoxins. Complete both sections (repeat sections for each major accomplishment):

Accomplishment:

Our most important accomplishment was the release of 5 new soft winter wheat varieties with FHB and preharvest sprouting resistance. Two of the varieties have *fhb1* from marker assisted backcrossing and three have native resistance. Except for the branded varieties sold by Seedway (Growmark) all varieties marketed in NY have at least moderate resistance to FHB.

Impact:

Our new varieties are rapidly gaining acceptance and certified seed is available for our most recent variety this fall. Now there are both white and red soft winter wheat varieties available in the northeastern U.S. Un-tested, branded varieties have come into NY in recent years and are reducing impact of our new varieties. Some are not entered in our state trials and we cannot legally evaluate them for FHB resistance, thus creating problems for farmers. This limits our ability to keep susceptible wheat varieties out of the state. In spite of this limitation, we are making great progress in eliminating susceptible varieties.

Project 2: *Coordinated Evaluation and Utilization of Marker Assisted Selection.*

1. What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?

Our goal for this project is to evaluate the effectiveness of use of FHB-resistance QTL in the northern winter wheat breeding programs through marker assisted selection. We also are quantifying the effects of those QTL on reducing FHB and DON and their impact on other important traits such as yield and milling and baking quality.

2. List the most important accomplishment and its impact (i.e. how is it being used) to minimize the threat of Fusarium head blight or to reduce mycotoxins. Complete both sections (repeat sections for each major accomplishment):

Accomplishment:

Last year we identified the lines in our programs that have been genotyped as homozygous for the resistance alleles at FHB QTL in our seed increase plots. Those lines were then distributed to cooperators in fall 2010 for 2011 and 2012 evaluation.

Impact:

This project is providing critical, quantitative information on the effect of genetic background on QTL expression as well as which lines to use as parents in the breeding programs. Lines worthy of joint germplasm and/or cultivar release can then be identified.

Project 3: *Improved Breeding for FHB Resistance by Advanced Genetic and Phenotypic Characterization of Soft Winter Wheat.*

1. What major problem or issue is being resolved relevant to Fusarium head blight (scab) and how are you resolving it?

Our goal for this project was to implement and evaluate the efficacy of genomic selection (GS) for FHB resistance. Strong to moderate resistance to FHB exists in Eastern US Soft Winter Wheat including Type I & II as well as resistance to kernel infection (RKI) and toxin accumulation (RTA). A combination of all types of resistance is needed to produce grain with low deoxynivalenol (DON) reliably. Recent studies such as the one we recently published in *The Plant Genome* (Rutkoski et al 2012) indicate that there are many QTL with small effects. This project will provide substantiating evidence for the efficacy of GS for FHB resistance.

2. List the most important accomplishment and its impact (i.e. how is it being used) to minimize the threat of Fusarium head blight or to reduce mycotoxins. Complete both sections (repeat sections for each major accomplishment):

Accomplishment:

We have presented a talk at the USWBSI Forum and published a paper (Rutkoski et al 2012) describing the utility of GS using 3 years of cooperative FHB nursery severity, incidence, damaged kernels, and DON data (see citation) and the results were quite promising. Cross validation of genomic estimated breeding values compared to phenotypic values resulted in correlations ranging from 0.3 to 0.7.

We provided 10 elite lines with excellent FHB resistance and 100 lines with varying FHB resistance from multiple crosses involving the elite parents and parents with less FHB resistance. These were included along with 70 common lines in an FHB evaluation in our FHB screening nursery for incidence and severity last year and continued this year. After harvest last year we evaluated percent diseased kernels and sent samples for DON testing. This will be repeated this year.

Impact:

Traditional mapping and MAS approaches may not be effective given the potentially large number of unique resistance sources and that most variation is controlled by genes with small effect. This project, combined with the information in our earlier study on GS have set the stage for greatly enhancing the rate of genetic gain from selection for FHB resistance using genomic selection methods.

Include below a list of all germplasm or cultivars released with full or partial support of the USWBSI. List the release notice or publication. Briefly describe the level of FHB resistance.

Jensen Soft White Winter Wheat - Crop Science Registration manuscript in preparation. A release notice has been distributed through the Cornell Cooperative Extension Network. FHB resistance is moderate and native in origin.

Saranac Soft White Winter Wheat - Crop Science Registration manuscript in preparation. A release notice has been distributed through the Cornell Cooperative Extension Network. FHB resistance is moderate and Chinese in origin.

Hopkins Soft White Winter Wheat - Crop Science Registration manuscript in preparation. A release notice has been distributed through the Cornell Cooperative Extension Network. FHB resistance is moderate and Chinese in origin.

Medina Soft White Winter Wheat - Crop Science Registration manuscript in preparation. A release notice has been distributed through the Cornell Cooperative Extension Network. FHB resistance is moderate and native in origin.

Otsego Soft Red Winter Wheat - Crop Science Registration manuscript in preparation. A release notice has been distributed through the Cornell Cooperative Extension Network. FHB resistance is moderate and native in origin.

All of these varieties have been made available for licensing and Foundation seed quantities are adequate. Jensen has been licensed for sale by 4 seed companies, Hopkins has been licensed by 2, and Medina by 1 company.

Include below a list of the publications, presentations, peer-reviewed articles, and non-peer reviewed articles written about your work that resulted from all of the projects included in the grant. Please reference each item using an accepted journal format. If you need more space, continue the list on the next page.

Sorrells, M.E. Bishop-Tran, A., Rutkoski, J., Benson, J., Guedira-Brown, G., and Heffner, E. 2010. Genomic Selection for Fusarium Head Blight Resistance in Wheat. Abstract – USWBSI, December 2010.

Rutkoski, J., J. Benson, Y. Jia, G. Brown-Guedira, J-L. Jannink, and M.E. Sorrells. 2012. Evaluation of genomic prediction methods for fusarium head blight resistance in wheat. The Plant Genome. In press.

Registration articles are in preparation.